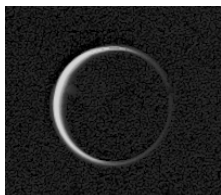


# Titan and the Other Moons of Saturn

*Titan's thick, opaque atmosphere obscures the surface.*



## LESSON TIME

*May be carried out over two days; total time 90 minutes.*

## PREPARATION TIME

*Allow time to make copies and collect materials.*

## MATERIALS CHECKLIST

*For the teacher:*

- “Saturn’s Moons” chart (transparency or copy)

*For each student:*

- A copy of the moon illustrations
- Scissors; glue; writing paper; pencil
- One piece of 12 x 18 inch construction paper
- Science Notebooks

## STUDENT PREREQUISITES

*Students should have some basic background information about Saturn’s moons.*

## LESSON NO. 8

*Language Arts Focus — Descriptive Scientific Language*

*Science Focus — Sorting by Scientific Characteristics*

## OVERVIEW

In this lesson, students learn that Saturn has many moons and that the Cassini–Huygens mission may discover even more moons. Students will examine and sort through images of Saturn’s varied moons to see characteristics they share and those which set them apart. Students will write a paragraph about Saturn’s moons and explain how they sorted them.

## BACKGROUND

Saturn has 18 named moons and we know of a total of 31 moons at last count. Titan was the first moon to be discovered — that’s not surprising, since it is the largest of Saturn’s moons. Most of Saturn’s smaller moons were discovered by the two Voyager spacecraft during the 1980–1981 flybys. It is exciting to think about other moons that the Cassini–Huygens mission may discover. The icy moons of Saturn are indeed an interesting and very diverse set of orbiting satellites. See the “Saturn’s Moons” chart for an overview of their various characteristics (the chart can be adapted for students).

For more information on Titan and Saturn’s other moons see:

<http://saturn.jpl.nasa.gov/science/titan.cfm>

<http://saturn.jpl.nasa.gov/science/icy-satellites.cfm>

## Objectives

Students will:

1. Learn that the moons of Saturn are diverse.
2. Learn that the moons have identifiable characteristics.
3. Learn that Saturn’s moons, like our Moon, reflect light.
4. Sort and classify Saturn’s moons by their characteristics.
5. Write a paragraph describing the moons’ characteristics and explaining the basis for how the moons were sorted.



## Teacher Preparation

Make a copy, for each student, of the moon illustrations (18 moons, two pages). Gather other materials needed for each student — construction paper can be any color. Make a photocopy, or a transparency, of the “Saturn’s Moons” chart (two pages) for discussion. Optional: you may wish to make copies of this chart for the students; there is a column for new information that Cassini–Huygens may discover about the moons.

teacher

**TIP**

The book “Saturn” by Elaine Landau is an excellent resource for understanding Saturn’s moons.

## Procedure

### Day One

*Building Background Information — 45 minutes*

1. Students will need some background information about the moons of Saturn.
2. Use the “Saturn’s Moons” chart to guide your discussion. Recommended for enriching background information is the book *Saturn* by Elaine Landau.
3. During your discussions, highlight the following:
  - Saturn is so far away from Earth that seeing and studying its moons is very difficult.
  - Scientists hope to learn many new things about the moons during the Cassini–Huygens mission.
  - The moons of Saturn have various sizes, shapes, colors, surfaces, and orbital patterns.
  - Titan is the largest of Saturn’s moons and has a very complex atmosphere.
  - The Huygens probe will be dropped into the atmosphere of Titan to get information about this large moon and will send exciting science results back to Earth.
3. Show the moon illustrations to your students as you introduce the moons’ diverse attributes — their varied shapes, sizes, surfaces, and colors. Write on the board any descriptive words that you and your students generate in your class discussions. If you have created a Saturn Word Wall, be sure to add these new words.
4. Distribute a set of moon illustrations to each student. Discuss each moon, asking students to describe what they see. Allow students time to color the moons as you discuss them. Use the “Saturn’s Moons” chart as your guide for discussion.
5. Have students write their names on their illustrations; collect for the follow-up sorting activity.

### Day Two

*Sorting Moons by Attribution and Writing — 45 minutes*

1. Return their moon illustrations to the students.
2. Have students cut the illustrations apart into individual “moon cards.” They should have 18 separate cards, each one illustrating a moon.



3. Ask students to sort their moon cards according to the moons' different attributes. Give students the opportunity to sort the moons several times, using different criteria. For example, the moons might be sorted by shape (spherical and irregular), color (white, orange, etc.), or type (shepherding, co-orbital, etc.). Encourage students to come up with their own ideas for sorting.
4. When students are finished, ask them to pick their favorite "sort." Give each student a piece of 12 x 18 inch construction paper and have them glue the sorted moons onto their construction paper. They should glue the moons just as they were sorted.
5. After they have completed gluing down their moon cards, have students write a descriptive paragraph explaining how they sorted their moons. Be sure to have them include the categories they generated for sorting as well as a brief explanation about the reasons for sorting the moons as they did. Encourage the use of the descriptive language generated during earlier classroom discussions.
6. Take some time to have students share their ideas about their sorting. Students should be able to explain to their peers how they sorted their moons, and recount why they chose that particular way to sort them.

### Using Science Notebooks

Writing prompts for this lesson:

1. Focus question: What are some of the differences among Saturn's moons?
2. Process question: How many ways did you sort the moons of Saturn? What were those ways?

### Extension Activity

This lesson focuses on the 18 named moons of Saturn. Students can create a blank grid, based on the grid for the "Saturn's Moons" chart, which can be filled out as more moons are discovered and named. The chart contains a "new information" column that can be filled in as we learn more about the many moons of Saturn. Happy moon hunting!

### Why This Works

One way to enhance student learning of new information is to provide them with an opportunity to "manipulate" that new information. Here manipulation takes the form of careful examination and sorting of images of Saturn's varied moons. Sorting activities of this kind require that students pay close attention to a variety of characteristics. They also help students develop the higher-level thinking skill of differentiating between common and unique characteristics.

Sorting and classifying are important scientific skills. As students select discrete data from a larger set, and then describe that selection process in their paragraphs, they are thinking and writing much like scientists do.



## Assessment

Student sorting and classification will indicate how much they have learned in this lesson. Students' writing about their method of sorting and their description of how they have classified the moons will allow you to evaluate student learning.

## Standards

### *NCTE Standards for the English Language Arts*

- Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.
- Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

### *National Science Education Standards*

#### Physical Science

- Position and motion of objects

#### Earth and Space Sciences

- Objects in the sky



## Saturn's Moons

Name	color	craters	shape	Atmosphere	Orbit type	New Information
<b>Titan</b>	orange	unknown	round	yes	Synchronous rotation*	
<b>Mimas</b>	gray	yes	round	no	Synchronous rotation*	
<b>Enceladus</b>	pure white	no	round	no	Synchronous rotation*	
<b>Tethys</b>	white	yes	round	no	Synchronous rotation*	
<b>Dione</b>	light brown	Yes	round	no	Synchronous rotation*	
<b>Rhea</b>	light brown	yes	round	no	Synchronous rotation*	
<b>Iapetus</b>	White/dkred	yes	round	no	Synchronous rotation*	
<b>Atlas</b>	unknown	unknown	irregular	no	Shepherding**	
<b>Pandora</b>	gray	yes	irregular	no	Shepherding**	
<b>Prometheus</b>	unknown	yes	irregular	no	Shepherding**	
<b>Janus</b>	gray	yes	irregular	no	Co-orbital***	
<b>Epimetheus</b>	gray	yes	irregular	no	Co-orbital***	
<b>Calypso</b>	gray	unknown	irregular	no	Lagrangian****	
<b>Helene</b>	unknown	yes	irregular	no	Lagrangian****	
<b>Telesto</b>	unknown	unknown	irregular	no	Lagrangian****	
<b>Hyperion</b>	light brown	yes	irregular	no	Chaotic*****	
<b>Phoebe</b>	Unknown	yes	round	no	Synchronous rotation*	
<b>Pan</b>	unknown	unknown	irregular	no	Embedded*****	

\*Synchronous rotation - The orbiting body (moon) takes as long to rotate on its axis as it does to make one orbit and always keeps the same hemisphere pointed at the body it is orbiting.

\*\*Shepherding - Moons that orbit along side a ring. Their gravitational effects keep the edges of the rings sharp and distinct. If the shepherding moons were not present, the ring material would have a tendency to spread out.

\*\*\*Co-orbital - Moons that share, or nearly share the same orbit.

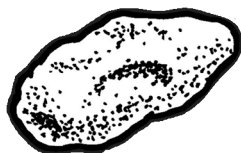
\*\*\*\*Lagrangian - Lagrangian moons orbit in the Lagrangian points of larger moons. These are locations within an object's orbit in which a less massive body can move in an identical stable orbit.

\*\*\*\*\*Chaotic - The moon, Hyperion, tumbles around at random in its orbit, never repeating its orbit exactly. Hyperion is a moon of Saturn that is tugged by the gravitational pull of both Saturn and another moon, Titan. Because of this gravitational pull, Hyperion changes both its rotational speed and its axis of rotation.

\*\*\*\*\*Embedded - Pan, a small moon, is embedded in the A ring and helps to clear the Encke division of particles.



Pan



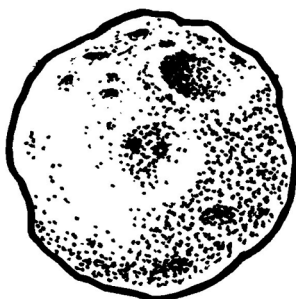
Atlas



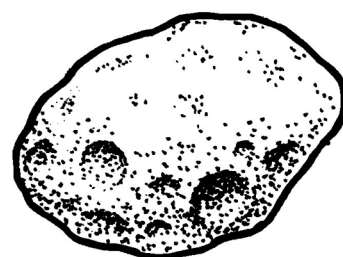
Prometheus



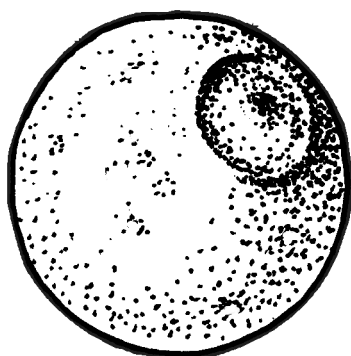
Pandora



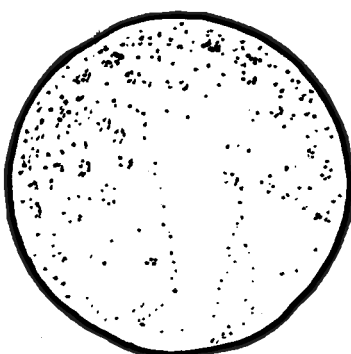
Epimetheus



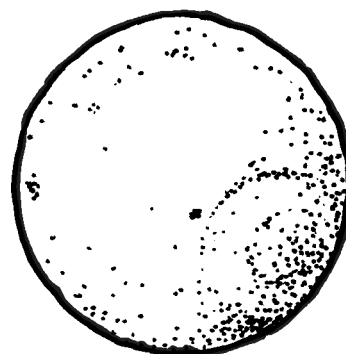
Janus



Mimas



Enceladus



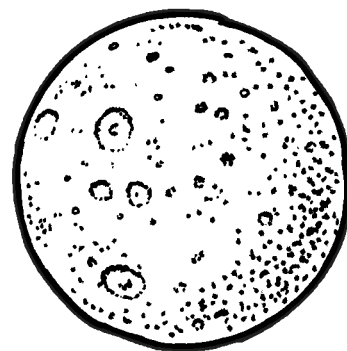
Tethys



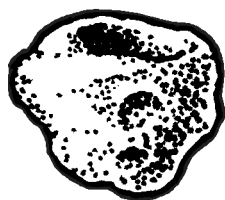
Telesto



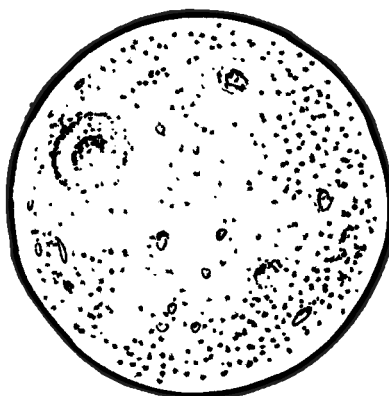
Calypso



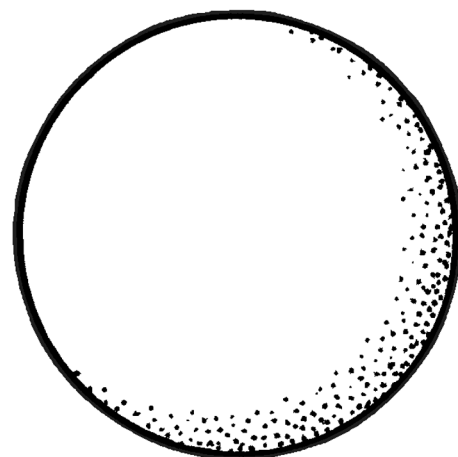
Dione



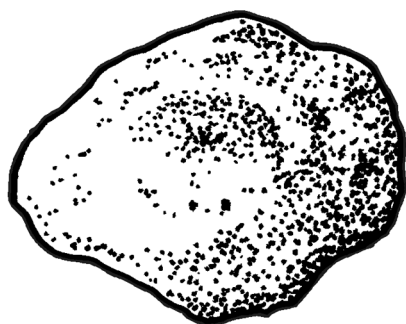
Helene



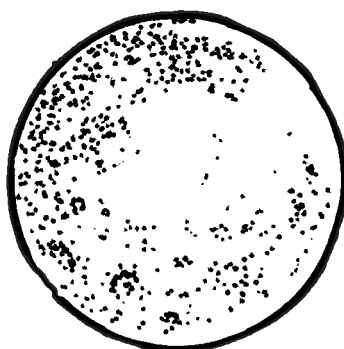
Rhea



Titan



Hyperion



Iapetus



Phoebe